KURENAI : Kyoto University Research Information Repository

Title	THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN SYSTEMATIC ACCOUNT II. -FAMILIES PARACALANIDAE AND PSEUDOCALANIDAE-
Author(s)	Tanaka, Otohiko
Citation	PUBLICATIONS OF THE SETO MARINE BIOLOGICAL LABORATORY (1956), 5(3): 367-406
Issue Date	1956-12-20
URL	http://hdl.handle.net/2433/174564
Right	
Type	Departmental Bulletin Paper
Textversion	publisher

Kyoto University

THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN SYSTEMATIC ACCOUNT II.

FAMILIES PARACALANIDAE AND PSEUDOCALANIDAE

OTOHIKO TANAKA
Fisheries Department, Faculty of Agriculture, Kyushu University

With 17 Text-figures

Family PARACALANIDAE

Genus *Paracalanus* BOECK, 1884

Three species belonging to this genus have been collected from the Izu region: *Paracalanus aculeatus* GIESBRECHT, *P. parvus* (CLAUS) and *P. denudatus* SEWELL. It has been reported by many authors that some of the species have two forms differing from each other mainly in size. The specimens belonging to this genus are, generally, of small size, and structually alike; one cannot get a correct taxomonic determination of the species, unless he observes to every minute point of structure. Moreover, there happens, often, some variations in the armature and structure of the swimming legs, especially, in the 5th legs of the female. From the Japanese waters, MORI recorded the occurrence of *P. aculeatus* and *P. parvus*. SEWELL recorded from the Indian seas the occurrence of *P. aculeatus*, *P. serratipes* SEWELL, *P. denudatus* SEWELL, *P. parvus* (CLAUS), *P. nannus* SARS, *P. crassirostris* DAHL, *P. dubia* SEWELL and *P. nudus* SEWELL; he arranged them into two groups, namely, the *aculeatus* and the *parvus* groups; the former three belong to the *aculeatus* and the latter five to the *parvus* group.

Paracalanus aculeatus GIESBRECHT

Paracalanus aculeatus GIESBRECHT, 1892, p. 146, t. 9; WOLFENDEN, 1909, p. 998; A. SCOTT, 1909, p. 26; SEWELL, 1914, p. 204; FARRAN, 1929, p. 222; SEWELL, 1929, p. 62; FARRAN, 1936, p. 79; MORI, 1937, p. 30, pl. 11; VERVOORT, 1947, p. 127.

Length. Female; 1.18–1.36 mm. Male; 1.27–1.36 mm.

Remarks. The present female specimen, though much larger in size than those described by SEWELL as *P. aculeatus* forma *major* taken from the Indian sea, agrees

fairly well with his description. The lengths of the terminal spine on the 3rd joint of the exopodite of the 2nd and 3rd legs appear somewhat shorter, when compared with SEWELL's figures. A transversal row of the spinules on the distal margin of the 5th legs is much reduced, and only a single spinule was observed near the inner distal margin; in the SEWELL's figure, the spinule on the distal margin is three in number. In the male the proportional lengths of the joint of the left 5th leg differ from those given by SEWELL (1914, p. 208, 15:15:15:12); the 4th joint is the longest in my specimen (20:13:21:25:21=100).

Occurrence. The species is fairly common, but not abundant.

Distribution. The species appears to be distributed in the tropical and subtropical regions of the oceans. In Japan it has been recorded from the warm regions.

Paracalanus denudatus SEWELL

(Fig. 6, *a–b*)

Paracalanus denudatus SEWELL, 1929, p. 66, fig. 23; FARRAN, 1936, p. 80, fig. 1.

Female. Length, 0.74–0.81 mm. The specimen closely resembles *P. aculeatus* forma *major*. The dorsal profile exhibits a slight hump about the middle of the fused mass of the head and the 1st thoracic segment. The abdomen is contained 3.6-times in the length of the cephalothorax. The abdomen 4-segmented; the segments and furca are in the proportional lengths 35:10:9:24:22=100; the genital segment wider than long; the genital orifice as that of *P. aculeatus* forma *minor*; the furcal rami about 2-times as long as wide, and set close together.

The 1st antenna exceeds the end of the abdomen by terminal two joints; the distal joint is 1.6-times as long as the penultimate one; the joints 8 and 9 are completely separate; the joints 10 to 22 are furnished with rows of minute spinules on the posterior margin.

In the 1st leg the 1st joint of the exopodite is furnished with a minute outer edge spine. In the 2nd to 4th legs the spinulation on the posterior surface of the 2nd joint of the endopodite, and the outer marginal teeth on the 3rd joint of the exopodite are much reduced; the number of spines on these joints, and the proportional lengths of the 3rd joint of the exopodite to the end spine are as follow:

	Present specimen				SEWELL'S specimen				FARRAN'S specimen	
	Sp. Ri 2	Sp. Re 3	Re 3	Spt.	Sp. Ri 2	Sp. Re 3	Re 3	Spt.	Re 3	Spt.
2nd	2–3	5–6	100	138	2	5	100	136	100	128
3rd	3–5	8–11	100	118	3	8	100	126	100	104
4th	4–5	7–8	100	109	4	4	100	103	100	85

The 5th pair of legs are small, and resemble those of *P. aculeatus* forma *minor*; the 1st joint about as long as the 2nd; the 2nd joint about 3-times as long as wide, ending in two unequal terminal spines. The other specimen, measuring 0.8 mm, had 3-jointed 5th legs which resemble those of *P. denudatus* figured by SEWELL (fig. 23, *h*); another specimen (0.74 mm) had an abnormal 5th legs as those figured by SEWELL as the 5th legs of *P. aculeatus* forma *minor*.

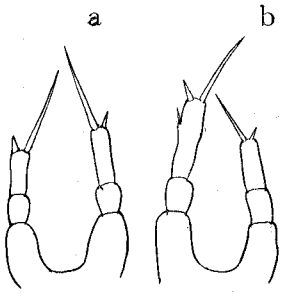

Fig. 6. *Paracalauns denudatus* SEWELL.
a, *b*, Female: abnormal 5th legs.

Remarks. The present specimen, though larger in size than those reported by SEWELL, agrees more closely to *P. denudatus* than to *P. aculeatus* forma *minor* SEWELL in having a long furcal rami, the armature of the 3rd joint of the exopodite, and the proportional lengths of the 3rd joint of the exopodite to the endspine of the 2nd to 4th legs. The 5th pair of legs differ from the type figured by SEWELL, but according to FARRAN, the 5th legs are 3-jointed, and sometimes 2-jointed.

Occurrence. The species has been obtained from the surface; it is not common here.

Distribution. The species has been recorded from the Indian seas and Great Barrier Reef.

Paracalanus parvus (CLAUS)

Paracalanus parvus GIESBRECHT, 1892, p. 164, t. 1, 6, 9; G. O. SARS, 1903, p. 17; ESTERLY, 1905, p. 140; WOLFENDEN, 1906, p. 998; A. SCOTT, 1909, p. 27; SATO, 1903, p. 15; SEWELL, 1914, p. 208; WITH, 1915, p. 54; ESTERLY, 1924, p. 86; G. O. SARS, 1925, p. 24; FARRAN, 1926, p. 233; GURNEY, 1927, p. 143; FARRAN, 1929, p. 221; SEWELL, 1929, p. 68; WILSON, 1932, p. 38; FARRAN, 1936. p. 80; MORI, 1937, p. 29, pl. 11; VERVOORT, 1947, p. 130.

Female. Forma *minor*: length, 0.74–0.82 mm. The head evenly rounded in lateral view; the line of demarcation between the head and the 1st thoracic segment is entirely undetectable. The abdomen is contained 3.7-times in the length of the caphalothorax; the proportional lengths of the abdominal segments and furca 26 : 16 : 13 : 26 : 19 = 100.

The 1st antenna exceeds the end of the abdomen by terminal one joint.

In the swimming legs the number of the outer marginal teeth on the 3rd joint of the exopodite of the 2nd to 4th legs are 8–9, 14 and 17 respectively; in the 2nd and 3rd legs the outer margin between the proximal and the distal spine of the 3rd joint of the exopodite bears two or three spine; these spines are entirely absent in the 4th leg.

The 5th leg 2-jointed; the 1st joint swollen; the 2nd joint 3.7-times as long as wide, and has the inner marginal seta which is little longer than the 2nd joint.

Remarks. The present specimen agrees well with the description and the figures of *P. parvus* given by SEWELL in the following: small in size; the proportional lengths of the abdomen to the cephalothorax; the armature of the exopodite of the 2nd to 4th legs. But the 1st antenna and the endspine on the 3rd joint of the exopodite of the 2nd-4th legs are longer in proportion than those given by SEWELL.

Female. Forma *major*: length, 0.92-0.98 mm. The head separates incompletely from the 1st thoracic segment, and is humped along the dorsal line about the middle. The abdomen is contained about 3.4-times in the length of the cephalothorax; the proportional lengths of the abdominal segments and furca are 27 : 16 : 14 : 25 : 18=100; the furcal rami about 2-times as long as wide.

The 1st antenna extends to the end of the abdomen; the terminal joint 1.3-times as long as the penultimate one.

In the swimming legs the proximal outer margin of the 3rd joint of the exopodite of 2nd to 4th legs have 13, 15 and 27 teeth respectively; the proportional lengths of the 3rd joint of the exopodite to the endspine are as follows:

	Re 3	forma *major* Spt.	teeth	Re 3	forma *minor* Spt.	teeth
2nd	100	114	13	100	130	8-9
3rd	100	95	15	100	106	14
4th	100	75	27	100	83	17

The 5th leg 2-jointed; the proximal joint much swollen; the 2nd joint 3.4-times as long as wide, ends in two unequal spines; the spine on the inner distal margin 1.4-times as long as the joint itself.

Remarks. The specimen differs from the foregoing in the following: larger in size; the dorsal line of the head humped; the armature of the exopodite of the 2nd to 4th legs; the proportional lengths of the endspine to the 3rd joint of the exopodite of the 2nd to 4th legs.

Male. Length, 0.84-0.96 mm. The head has a small transparent swelling on the mid-dorsal line about the opposite position to the base of the 1st antenna. The abdomen is contained about 2.0-2.7-times in the length of the cephalothorax; the proportional lengths of the abdominal segments and furca are 10 : 23 : 17 : 18 : 16 : 16 =100, measured laterally along the dorsal line.

The 2nd joint of the exopodite of the 2nd to 4th legs is dentate on the outer margin; the teeth on the 3rd joint of the exopodite of the 4th leg are finer than those of the female.

The right 5th leg 2-jointed; the left leg 5-jointed; the terminal joint is furnished with two short spines.

Remarks. Two size groups are also detectable in the male of *P. parvus*; the small-sized measured from 0.84-0.88 mm; the large-sized measured from 0.88-0.96 mm;

they differ only in size; the former has somewhat longer abdomen than that of the latter.

Occurrence. The common species in the surface layer in the Izu rigion.

Distribution. The species is widely distributed in the warm regions of the oceans.

Genus *Acrocalanus* GIESBRECHT, 1888

Four species belonging to this genus have been recorded from the Japanese waters, of which three species occured in the present collection: *A. gracilis* GIESBRECHT, *A. longicornis* GIESBRECHT and *A. gibber* GIESBRECHT. The genus *Acrocalanus* differs from *Paracalanus* in the following: short abdomen; long 1st antenna; the 4th thoracic segment separates incompletely from the 5th; the armature on the joints of the exopodite of the 2nd to 4th legs; the distal outer margin of the endopodites end in a small spine; the female 5th leg absent or rudimentary; the male 5th legs present only on the left side. The male specimens of *Acrocalanus* resemble so closely each other that it is troublesome to connect the males with the corresponding females. In the present collection, the male specimens are represented by three species *A. gracilis*, *A. longicornis* and *A. gibber*.

Acrocalanus gracilis GIESBRECHT

Acrocalanus gracilis GIESBRECHT, 1892, p. 171, t. 6, 10; WOLFENDEN, 1906, p. 1000; A. SCOTT, 1909, p. 29; SEWELL, 1912, p. 395, 359; SEWELL, 1929, p. 79; FARRAN, 1936, p. 81; MORI, 1937, p. 31, pl. 12; VERVOORT, 1947, p. 134.

Female. Length, 1.25–1.32 mm. The head is evenly rounded; the line of demarcation between the head and the 1st thoracic segment very slight. The abdomen is contained 3.8-times in the length of the cephalothorax; the abdominal segments and furca in the proportional lengths 31 : 10 : 10 : 24 : 24 = 100; the furcal rami about 1.7-times as long as wide.

The 1st antenna extends beyond the end of the abdomen by distal three or four joints.

In the swimming legs the basal joints, the exopodite and endopodite are furnished with spinule, but the distal joint of the exopodite of the the 3rd leg has spinules only on the proximal half of the outer margin. The proportional lengths of the 3rd joint of the exopodite to the endspine in the 2nd to 4th legs are 94 : 100, 69 : 100 and 62 : 100 (length of the 3rd point taken as 100). The armature of the outer margin of the 2nd and 3rd joint of the 2nd to 4th legs as follows:

	2nd leg	3rd leg	4th leg
2nd joint	9	9	15
3rd joint, proximal part	8	10	16
3rd joint, distal part	6	0	14

The 5th pair of legs are, in most cases, absent; some of the specimen had a rudimentary 3-jointed 5th leg on the left side.

Occurrence. A vertical haul from the depth 300 m to the surface contained 19 females.

Distribution. The species appears to be distributed in the tropical and subtropical regions of the oceans.

Acrocalanus longicornis GIESBRECHT

Acrocalanus longicornis GIESBRECHT, 1892, p. 171, t. 6, 10; WOLFENDEN, 1906, p. 1000; A. SCOTT, 1909, p. 28; SEWELL, 1912, p. 358; FARRAN, 1929, p. 222; SEWELL, 1929, p. 82; FARRAN, 1936, p. 80; MORI, 1937, p. 31, pl. 12; VERVOORT, 1947, p. 33.

Female. Length, 1.14-1.28 mm. The head incompletely separates from the 1st thoracic segment; the dorsal profile of the head slightly humped. The abdomen is contained 3.8-times in the length of the cephalothorax; the proportional lengths of the abdominal segments and furca are 33 : 13 : 10 : 20 : 23=100; the furcal rami about 2-times as long as wide; the genital segment swollen below.

The 1st antenna extends beyond the end of the abdomen by distal five joints.

In the swimming legs the armature on the outer margin of the 2nd and 3rd joints of the exopodite, and the proportional lengths of the 3rd joint to the endspine of the 2nd to 4th legs are as follows:

		2nd leg	3rd leg	4th leg
Exopod 2		2	7-8	13
Exopod 3	proximal part	5	8-9	14-15
	distal part	5	0	43
Endspine		100	100	100
Exopod 3		86	61	56

The 5th leg absent; but some of the specimen has a rudimentary 3-jointed leg on the left side.

Occurrence. A vertical haul from the depth 300 m to the surface contained 10 female mixed with the foregoing.

Distribution. The species appears to have the similar distribution as that of *A. gracilis*, and has been recorded from the tropical and sub-tropical regions of the oceans.

Acrocalanus gibber GIESBRECHT

Acrocalanus gibber GIESBRECHT, 1892, p. 171, t. 6, 10; WOLFENDEN, 1906, p. 1003; A. SCOTT, 1909, p. 29; SEWELL, 1912, p. 315; SEWELL, 1914, p. 210; GURNEY, 1927, p. 147, fig. 18; SEWELL, 1929, p. 80; FARRAN, 1936, p. 81; MORI, 1937, p. 32, pl. 12; VERVOORT, 1947, p. 136.

Female. Length, 1.13 mm. The dorsal outline of the head is much humped; the separation of the head from the 1st thoracic segment is clearly made out. The abdomen is contained 3.85-times in the length of the cephalothorax; the abdomen 4-segmented, the segments and furca in the proportional lengths 31 : 11 : 10 : 25 : 23=100; the furcal rami about 2.3-times as long as wide.

The 1st antenna exceeds the end of the abdomen by terminal two joints.

The armature on the 2nd and 3rd joints of the exopodite of the 2nd to 4th legs, and the proportional lengths of the exopod 3 to the endspine are as follows:

	2nd leg	3rd leg	4th leg
Exopod 2	7	9	14
Exopod 3 proximal part	9	10	16
Exopod 3 distal part	4	0	5
Endspine	100	100	100
Exopod 3	78	64	55

In the 4th leg the proximal part of the outer margin of the 3rd joint of the exopodite is much longer than the distal part of the same joint.

Occurrence. The species is rare in the Izu region; only one specimen was collected in winter of 1934.

The male specimens of the genus *Acrocalanus* are closely related each other, and differ only in minute points of structure. In the present collection three representatives of the adult male were obtained. In the following I give a table, showing some structural differences in the males and females described by SEWELL:

Species	*A. gracilis*			*A. longicornis*			*A. gibber*		
Total length (mm) male	0.80–1.0			0.95–1.0			0.943		
Proportional lengths Abdominal segm. and furca	13 : 26 : 17 : 15 : 16 : 13			12 : 22 : 15 : 15 : 20 : 16			13 : 25 : 17 : 17 : 16 : 12=100		
Joints of 5th leg	25 : 13 : 24 : 20 : 18			23 : 14 : 25 : 20 : 18			26 : 12 : 25 : 22 : 15=100		
Exopod 2	2nd 22	3rd 25	4th leg 25	2nd 22	3rd 27	4th leg 27	2nd 24	3rd 26	4th leg 27
Exopod 3 dist.	19	20	17	22	21	20	19	20	18
Exopod 3 prox.	20	22	28	20	21	24	20	21	23
Endspine	39	33	30	36	31	29	39	33	32
No. of spine Exopod 2	10–11	11–12	17	8–10	12	16–20	11	13	20–22
Exopod 3 dist.	8	14	17	7–9	15	15–20	7–8	14–15	10–11
Exopod 3 prox.	11	15	22	9–10	13	23–25	10	15	25

Total length (mm) female	1.0			1.0			0.81		
Proportional lengths									
Exopod 2	28	26	26	21	27	27	23	27	28
Exopod 3 dist.	19	20	22	22	24	24	20	22	29
Exopod 3 prox.	20	22	23	20	20	22	20	21	27
Endspine	39	32	29	37	29	27	31	30	26

The male specimens of the present collection have the following figures:

Total length (mm)	1.20–1.24			0.955			1.40		
Proportional lengths									
Abdomen segm. and furca	12 : 25 : 18 : 16 : 18 : 11			11 : 24 : 17 : 15 : 20 : 13			13 : 25 : 17 : 17 : 15 : 13=100		
5th leg	24 : 22 : 21 : 17 : 16			23 : 25 : 20 : 17 : 15			18 : 26 : 22 : 18 : 16=100		
Exopod 2	23	27	27	22	27	27	24	25	27
Exopod 3 dist.	18	18	19	18	20	20	17	19	19
Exopod 3 prox.	21	24	25	23	23	20	22	23	22
Endspine	38	31	29	31	30	26	38	33	32

Comparing these figures each other, I am inclined to regard the large specimen (1.20–1.24 mm) as the male of *A. gracilis*, and the small specimen (0.955 mm) as the male of *A. longicornis*, and the largest specimen (1.40 mm) as the male of *A. gibber*.

Acrocalanus gracilis

Male. Length, 1.20–1.24. The proportional lengths of the cephalothorax to the abdomen are 99 to 36, so the abdomen is contained 2.75-times in the length of the cephalothorax. The abdominal segments and furca, measured in dorsal aspect, have the proportional lengths 12 : 25 : 18 : 16 : 18 : 11=100; the furcal rami 1.3-times as long as wide.

The 1st antenna exceeds beyond the posterior margin of the last thoracic segment by terminal three joints; the proportional lengths of the joints measured along the posterior margin are:

Joint	1–6	7–8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	286	58	22	27	31	31	40	40	45	45	45	45	45	45	45	45	45	40	27=1000.

The proportional lengths and the armature of the 2nd to 4th legs are as tabulated above.

The immature specimen in the copepodid stage V were also taken associated with the adult males and females. The total length of the specimen measured 1.07–

1.16 mm. The proportional lengths of the 2nd and 3rd joints of the exopodite to the endspine, and the number of spines on the outer margin of the 2nd and 3rd exopod of the 2nd to 4th legs are as follows:

Proportional lengths of the joints	2nd leg	3rd leg	4th leg
Exopod 2	21	24	24
Exopod 3 prox.	21	24	28
Exopod 3 dist.	18	18	18
Endspine	40	34	30
Number of spines on the outer margin			
Exopod 2	1	5	6
Exopod 3	5	6	9

The left 5th leg 4-jointed.

Acrocalanus longicornis

Male. Length, 0.955 mm. The proportional lengths of the cephalothorax to abdomen are 71 : 26, so the abdomen is contained 2.85-times in the length of the cephalothorax. The forehead narrowly rounded; a small transparent swelling is observed on the mid-dorsal line of the cephalon. The line of demarcation between the 4th and 5th thoracic segment can be clearly made out in lateral aspect. The rostrum is rather stout and short. The proportional lengths of the abdominal segments and furca, measured along the dorsal, are 11 : 24 : 17 : 15 : 20 : 13=100; the furcal rami 1.4-times as long as wide.

The 1st antennae reach back beyond the posterior margin of the last thoracic segment by the extent of the terminal three joints; the proportional lengths of the joints measured along the posterior margin are:

Joint	1-6	7-8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23	25
	274	63	29	34	35	40	40	46	46	46	47	46	46	46	46	46	46	40	29=1000.

The proportional lengths of the joints of 2nd to 4th legs are as tabulated above. The left 5th leg has the joints in the proportional lengths 23 : 25 : 20 : 17 : 15=100; the endspine of the 5th joint about 2/5 the length of the distal joint.

The immature male specimens in the copepodid stage V, measured 0.96-0.97 mm. The specimen has the swimming legs similar in structure to those of the female; the proportional lengths of the various joints and the number of the outer marginal spine on the 2nd and 3rd joint of the exopodite of the 2nd to 4th legs are as follows:

Proportional lengths of the joints		2nd leg	3rd leg	4th leg
Exopod 2		22	26	27
Exopod 3	prox.	20	22	26
	dist.	19	20	20
Endspine		37	32	27
Number of outer marginal spines				
Exopod 2		1	7	8
Exopod 3	prox.	5	6	10
	dist.	5	0	5

The endspine of the last joint of the left 5th leg is longer than that of the immature male of *A. gracilis*.

Occurrence. The adult males of *A. gracilis* and *A. longicornis* were collected in the vertical hauls in Sept. 1937 associated with the adult females.

Acrocalanus gibber

Male. Length, 1.40 mm. The head is evenly rounded; there is a small transparent swelling on the mid-dorsal line about the anterior one third of the head; the line of fusion between the head and the 1st thoracic segment can be made out in lateral aspect. The abdomen is contained 2.8-time in the length of the cephalothorax. The abdominal segments and furca in the proportional lengths 13 : 25 : 17 : 17 : 15 : 13=100.

The 1st antennae reach back beyond the posterior margin of the cephalothorax by the extent of two terminal joints.

The proportional lengths of the various joints, and the armature on the 2nd and 3rd exopod of the 2nd to 4th legs are as follows:

Proportional lengths of the joints		2nd leg	3rd leg	4th leg
Exopod 2		24	25	27
Exopod 3	prox.	22	23	22
	dist.	17	19	19
Endspine		38	33	32
Number of teeth				
Exopod 2		15	17	34
Exopod 3	prox.	13	15	29
	dist.	9	15	25

The 3rd joint of the exopodite of the 1st leg has a longitudinal row of spinules on the proximal part along the outer margin.

The 5th leg has the following proportional lengths, commencing from the base: 18 : 26 : 22 : 18 : 16=100.

The present specimen agrees fairly well with SEWELL's description of the male of *A. gibber*, but differs from it in the following: larger in size; the length of the 1st antenna; the proportional lengths of the 5th joints of the left 5th leg.

Occurrence. A single specimen in winter of 1934 from the surface.

Genus *Calocalanus* GIESBRECHT, 1888

From the Japanese waters only one species *Calocalanus pavo* (DANA) has been reported. In the present collection the following five species were detected: *C. pavo* (DANA), *C. plumulosus* (CLAUS), *C. styliremis* GIESBRECHT, *C. pavoninus* FARRAN, *C. gracilis* sp. nov.; the last species appears to be undescribed, and to which I give the name *C. gracilis*.

The general character of the genus resembles that of *Paracalanus*, but it is easily distinguished from the former in the segmentation, and the shape of the abdomen, and the proportional lengths of the joints of the 1st antenna.

Calocalanus pavo (DANA)

Calocalanus pavo GIESBRECHT, 1892, p. 175, t. 1, 4, 9; WOLFENDEN, 1906, p. 999; A. SCOTT, p. 30; SEWELL, 1914, p. 214; FARRAN, 1929, p. 222; SEWELL, 1929, p. 89; WILSON, p. 1932, p. 39; FARRAN, 1936, p. 83; MORI, 1937, p. 33, pl. 13. VERVOORT, 1947, p. 138.

Length. Female, 1.23 mm.

Occurrence. The species is not common here; one adult female was obtained in a vertical haul from 50 m to the surface in August 1937.

Distribution. The species is widely distributed in the tropical and subtropical regions of the Pacific, Atlantic and Indian Ocean.

Calocalanus plumulosus (CLAUS)

(Fig. 7, *d-e*)

Calocalanus pulmulosus GIESBRECHT, 1892, p. 176, t. 3, 9, 36; WOLFENDEN, 1906, p. 999; A. SCOTT, 1909, p. 31; SEWELL, 1914, p. 214; FARRAN, 1929, p. 223; SEWELL, 1929, p. 89; WILSON, 1932, p. 41; FARRAN, 1936, p. 83.

Female. Length, 1.00–1.18 mm. The body slender; the abdomen is contained about 5.2-times in the length of the cephalothorax; the abdomen 3-jointed; the furcal rami symmetrical.

The 1st antenna 24-jointed, exceeds the end of the furca; the terminal joint is 2-times as long as the penultimate one. The 5th leg somewhat differs from that figured by GIESBRECHT: the inner marginal seta on the apex of the 3rd joint is very short; the 3rd joint is about 8-times as long as wide, whereas it is 9-times in the GIESBRECHT's figure. Some specimens had slightly asymmetrical 5th pair of legs.

Male. Length, 0.88–0.90 mm. The head separate from the 1st thoracic segment and so is the 4th from the 5th. The abdomen is contained about 3.4-times in the length of the cephalothorax; the proportional lengths of the abdominal segments and furca are 17 : 21 : 19 : 17 : 15 : 12 = 100; the furcal rami about as long as wide.

The 1st antenna 21-jointed, exceeds the end of the cephalothorax by distal five joints.

The 1st leg with an inner marginal seta on the 1st basal joint. The 3rd leg has three groups of spinules on the posterior surface of the 3rd joint of the endopodite; the 2nd joint of the exopodite has a row of leaf-like spines on the outer margin, and also on the inner margin about proximal one-third of the joint. The 4th leg has a group of spinules on the posterior surface of the 3rd joint of the endopodite.

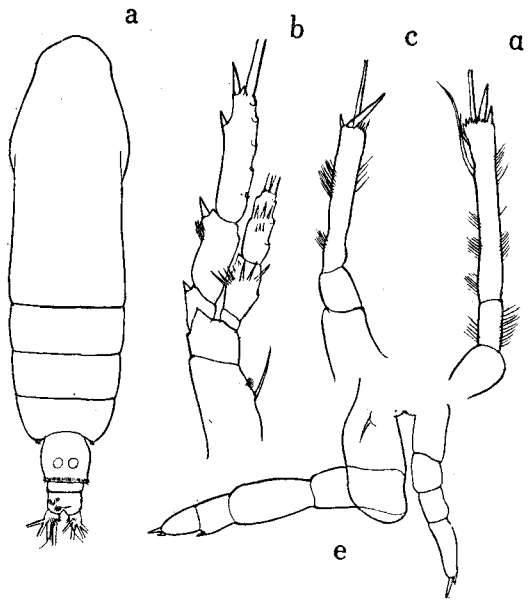

Fig. 7. *Calocalanus plumulosus* (CLAUS).
a, Female: dorsal aspect; *b*, 3rd leg; *c*, 5th leg; *d*, 5th leg, the other specimen; *e*, male: 5th pair of legs.

The 5th legs are similar in structure to those of *Calocalanus pavo*; the left leg 5-jointed; the right leg 4-jointed; the proportional lengths of the joints of the legs as follows:

	1	2	3	4	5
left leg	39	21	23	9	8 = 100
right leg	39	13	17	31	= 100

The proportional lengths of the corresponding joints in C. *pavo*, measured from the GIESBRECHT's figure are:

left leg	30	15	22	22	12 = 100
right leg	36	18	18	28	= 100

Occurrence. Common in the surface layer in summer season.

Distribution. The species is widely distributed in the tropical and sub-tropical regions of the oceans.

Calocalanus styliremis GIESBRECHT

(Fig. 8, *a–b*)

Calocalanus styliremis GIESBRECHT, 1892, p. 176, t. 3, 9, 36; WOLFENDEN, 1906, p. 999; G. O. SARS, 1925, p. 27; FARRAN, 1926, p. 234; FARRAN, 1929, p. 222; SEWELL, 1929, p. 89; FARRAN, 1936, p. 83.

There are two size groups in the female of *Calocalanus styliremis*: the small specimen can easily be referred *C. styliremis* and the large resembles *C. contractus* FARRAN. The small specimen measured 0.60–0.69 mm, and the large 0.75–0.84 mm. The small specimen is robust; the cephalothorax is 2.6-times as long as wide. The large specimen is rather slender and the cephalothorax is about 3-times as long as wide. The abdomen is contained about 5.3-times in the length of the cephalothorax in both specimens. The furca as long as wide. The 1st antenna exceeds the end of the furca by distal five joints; the joints 1 and 2 are separate; the last joint is, in small specimen, less than 2-times the length of the penultimate (21 : 12), whereas it is 2-times in the large specimen (30 : 14–16). The proportional lengths of the outer margin of the 3rd joint of the exopodite and the endspine of the 3rd leg are nearly the same in both specimens:

	proximal	distal	endspine
small-sized specimen	31	11	58
large-sized specimen	31	10	59

The 5th legs of the small specimen resemble those figured by GIESBRECHT; the distal joint is about 4-times as long as wide, and has a slight swelling on the proximal part. In the large specimen the distal joint is about 3-times as long as wide, and carries four spines at the base of the terminal spine.

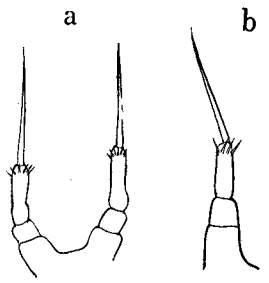

Fig. 8. *Calocalanus styliremis* GIESBRECHT. *a*, Female: 5th pair of legs; *b*, 5th leg of the large specimen.

According to GIESBRECHT the group of the spine on the posterior surface of the endopodite of the 3rd and 4th legs are constant in number, but they are three in the small specimen, and two in the large specimen.

Occurrence. Common, but only the female specimen has been taken in the Izu region.

Distribution. The species has a wide distribution in the tropical and sub-tropical regions of the oceans.

Calocalanus pavoninus FARRAN

(Fig. 9, *a–c*)

Calocalanus pavoninus FARRAN, 1936, p. 83, fig. 3.

Female. Length, 0.72 mm; cephalothorax, 0.62 mm, abdomen, 0.10 mm; so the abdomen is contained 6.2-times in the length of the cephalothorax; the cephalothorax 2.9-times as long as wide. The proportional lengths of the abdominal segments and furca are 43 : 33 : 34=100; the genital segment 2-times as wide as long, and has a marked ventral swelling; the anal segment 2-times as wide as long; the furcal rami about as long as wide.

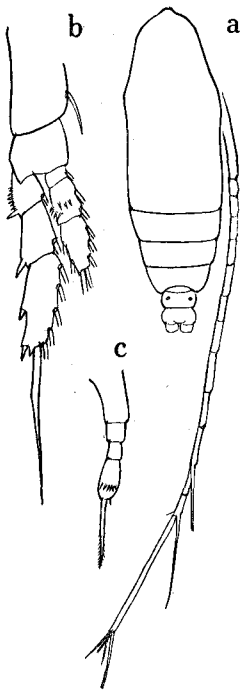

Fig. 9. *Calocalanus pavoninus* FARRAN. *a*, Female: dorsal aspect; *b*, 2nd leg; *c*, 5th leg.

The 1st antennae exceed the end of the abdomen by distal seven joints; the last joint is about 6-times as long as the penultimate one. The 1st leg has 3-jointed exopodite and endopodite. In the 2nd leg the 1st joint of the exopodite has about six teeth-like spines on the outer margin; the 2nd joint of the endopodite has rows of spinules on the posterior surface; the inner marginal seta absent on the 1st basal joint. In the 3rd and 4th legs the 2nd and 3rd joints of the endopodite have each groups of spinules on the posterior surface. The 5th leg 4-jointed; the terminal joint is gradually inflated at the distal end, and about as long as the length of the two basal joints taken together; a line of fusion can be clearly seen at the proximal one-third of the joint; there are a minute spinule at the base of the terminal seta and a transverse row of spinules.

Remarks. The present specimen agrees closely with *C. pavoninus* FARRAN, except minute differences in the structure of the 3rd and 5th legs.

Occurrence. Three adult females in the surface collection in August 1937.

Distribution. The species has been recorded from the Great Barrier Reef region.

Calocalanus gracilis TANAKA

(Fig. 10, *a–e*)

Calocalanus gracilis TANAKA, 1956, p. 7, fig. 3, *a–h*.

Female. Length, 0.62 mm. The body slender; the cephalothorax is 3.5-times as long as wide; the abdomen is contained 4.8-times in the length of the cephalothorax. The abdomen 3-jointed; the proportional lengths of the segments and furca are 40 : 8 : 32 : 20=100.

The distal joints of the 1st antenna missing; the proportional lengths of the joints 1–15 in 0.01 mm are as follows:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15
	3.2	4.1	2.3	1.8	2.3	2.3	2.3	3.2	1.8	1.8	2.0	2.3	2.7	2.7

The swimming legs small. The 1st leg has 2-jointed exopodite and 1-jointed endopodite; the 1st basal joint has small spines on the inner distal margin; the proximal joint of the exopodite has a seta on the inner margin about the middle. The 2nd to 4th legs have each 3-jointed exopodite and endopodite; the 1st joint of the exopodite of 2nd leg has four small spines on the outer margin at the base of the outer edge spine; in the 3rd and 4th legs the 2nd and 3rd joints of the endopodite are devoid of groups of spinule on the posterior surface; the leaf-like spines of the 2nd and 3rd joints of the exopodite also absent. The 5th leg 3-jointed; the terminal joint about as long as the 1st, and bears an endspine which is of equal length to the three joints taken together, and have a very minute spine on the outer distal corner of the joint.

Remarks. The specimen resembles *C. tenuis* FARRAN, when viewed from the dorsal, but its small size and the structure of the swimming legs separate the present specimen from the former.

Occurrence. One adult female in the vertical haul from the depth 50 m to the surface in August, 1937. A. FLEMINGER recorded in 1955 the occurrence of the species from the Gulf of Mexico. The description and figures were given in "Breviora," issued from the Museum of Comparative Zoology of Harvard University.

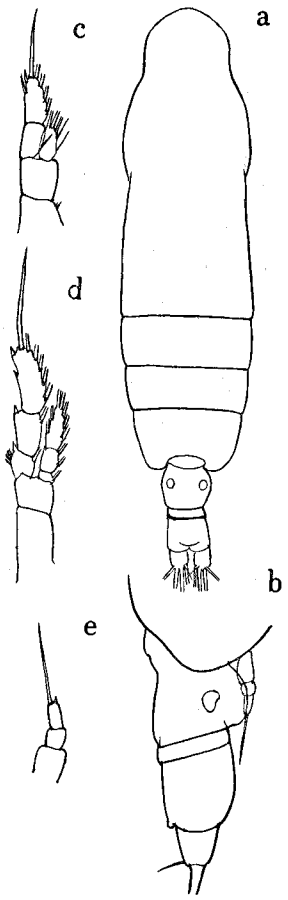

Fig. 10. *Calocalanus gracilis* TANAKA. *a*, Female: dorsal aspect; *b*, 1st thoracic segment and abdomen, lateral aspect; *c*, 1st leg; *d*, 2nd leg; *e*, 5th leg.

Family PSEUDOCALANIDAE

The family, at present, comprises eight genera, namely *Clausocalanus* GIESBRECHT, *Ctenocalanus* GIESBRECHT, *Pseudocalanus* BOECK, *Spinocalanus* GIESBRECHT, *Microcalanus* SARS, *Mimocalanus* FARRAN, *Monacilla* SARS, *Drepanopsis* WOLFENDEN and *Tanyrhinus* FARREN. These genera have the 1st antenna composed of 24 joints; the joints 8 and 9 are completely fused, except those of *Mimocalanus*, *Monacilla* and *Tanyrhinus*. In the swimming legs the exopodite of the 1st to 4th legs are 3-jointed;

the endopodite of the 1st leg 1-jointed, of the 2nd leg 2-jointed, of the 3rd and 4th legs 3-jointed. The number of the outer-edge spine on the terminal joint of the exopodite of the 2nd to 4th legs is three, and the number of the inner marginal setae of the same joints is five. The number of the setae on the distal joint of the endopodite of the 2nd to 4th legs is five, except *Spinocalanus, Monacilla* and *Tanyrhinus*; in these three genera the 3rd and 4th legs have four inner marginal setae, whereas in the remaining genera, there are six setae on the terminal joint of the endopodite. In the 1st leg the 1st to 3rd joints of the exopodite have each an outer-edge spine respectively, except *Microcalanus* and *Mimocalanus* which have no seta on the 1st joint of the exopodite, and *Tanyrhinus* which has no outer-edge spine on the 1st and 2nd joints of the exopodite. The armature on the face of the swimming legs are observed in *Spinocalanus, Monacilla* and *Drepanopsis*. The female 5th legs are absent or rudimentary, except in *Drepanopsis*. The male 5th legs are, in most cases, uniramose, except in *Spinocalanus* and *Monacilla* which have biramose 5th legs.

Considering the relationship among these genera, it is possible to divide them into the following four groups: (1) *Clausocalanus, Ctenocalanus, Pseudocalanus* and *Drepanopsis* and *Microcalanus*; (2) *Mimocalanus*; (3) *Spinocalanus* and *Monacilla*; (4) *Tanyrhinus*. FARRAN suggests that *Mimocalanus* is closely allied to *Paracalanus* in the segmentation of the 1st antenna.

Beside these genera, I found from the deep water of Suruga Bay, a specimen which had the swimming legs similar in structure to those of *Spinocalanus*. It differs from the genera given above also in the structure of the male 1st antenna, to which I propose a new generic name *Ryocalanus*.

Genus *Clausocalanus* GIESBRECHT, 1888

At the present time three species have been recorded from the Japanese waters; all of them appeared in the collection, namely; *Clausocalanus arcuicornis* (DANA), *C. furcatus* (BRADY) and *C. pergens* FARRAN.

Clausocalanus arcuicornis (DANA)

(Fig. 11, *a-d*)

Clausocalanus arcuicornis GIESBRECHT, 1892, p. 186, t. 2, 10, 36; ESTERLY, 1905, p. 142; WOLFENDEN, 1906, p. 999; A. SCOTT, 1909, p. 32; SEWELL, 1912, p. 360; G. O. SARS, 1925, p. 27; FARRAN, 1926, p. 237; GURNEY, 1927, p. 150; FARRAN, 1929, p. 223; SEWELL, 1929, p. 90; WILSON, 1932, p. 42; FARRAN, 1936, p. 82; TANAKA, 1937, p. 252; MORI, 1937, p. 34, pl. 13, 14; VERVOORT, 1947, p. 140.

Female. There are two size groups in the female of *C. arcuicornis*. SEWELL described these two forms from the Indian waters. FARRAN reported these two forms in "Copepoda of the Great Barrier Reef Expedition" too. I have detected the two forms from Suruga Bay.

Forma *minor*. Length, 1.18–1.29 mm. The abdomen is contained 3.0–3.4-times in the length of the cephalothorax; the rostrum is slender, and bents slightly backwards. The 5th legs (Fig. 11 *a*) are quite different from those of forma *major* (Fig. 11 *b*).

Forma *major*. Length, 1.41–1.52 mm; the abdomen is contained 2.7–2.8-times in the length of the cephalothorax; the rostrum is stout and rather straight.

Male. Two different types are observed in the male specimen; the difference lies in the structure of the 5th legs; the one, measuring 1.23 mm, has the 5th legs as those hitherto been described (Fig. 11 *b*); the other measuring 1.07–1.29 mm in total length, have a very slender distal joint in the right 5th leg (Fig. 11 *d*). The latter specimens occurred both from the surface and deep waters; the surface specimens are slightly larger (1.23–1.29 mm) than those of the deep waters (1.07 mm).

Occurrence. Very common.

Distribution. The species has a wide distribution in the warm and temperate regions of the oceans.

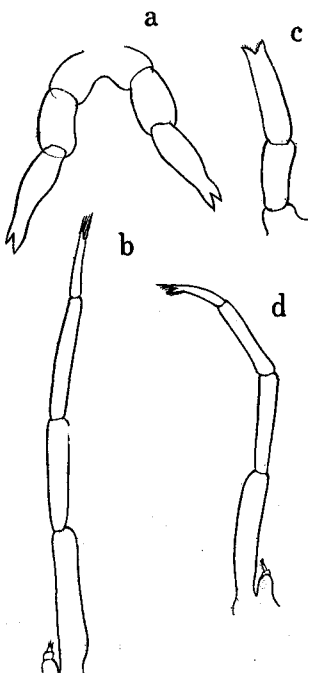

Fig. 11. *Clausocalanus arcuicornis* DANA. *a*, Female, forma *major*: 5th pair of legs; *b*, Male: 5th pair of legs; *c*, Female, forma *minor*: 5th legs; *d*, Male: 5th pair of legs.

Clausocalanus furcatus (BRADY)

Clausocalanus furcatus GIESBRECHT, 1892, p. 186, t. 36; WOLFENDEN, 1906, p. 1007; A. SCOTT, 1909, p. 32; SEWELL, 1914, p. 215; SARS, 1925, p. 28; FARRAN, 1929, p. 225; SEWELL, 1929, p. 93; FARRAN, 1936, p. 81; MORI, 1937, p. 35, pl. 14; VERVOORT, 1947, p. 144.

Length. Female, 1.08–1.18 mm. Male, 0.85 mm.

Occurrence. One of the most common species in the Izu region.

Distribution. The species has a wide distribution in the warm region of the oceans.

Clausocalanus pergens FARRAN

Clausocalanus pergens FARRAN, 1926, p. 239; MORI, 1937, p. 35, pl. 14.

Female. Length, 0.99 mm. The abdomen is contained 2.8-times in the length of the cephalothorax; the proportional lengths of the abdominal segments and furca are 34 : 21 : 19 : 12 : 14 = 100. The rostrum slender, slightly bent backwards. The 1st

antenna extends to the middle of the genital segment. In the 2nd leg the teeth on the distal margin of the 2nd basal joint are long and slender. The 5th leg ends in two closely-set points.

Occurrence. One adult female from the vertical haul from 1000 m to the surface in Suruga Bay on 25 June, 1937.

Distribution. The species appears to have a wide distribution, and has been recorded from the Bay of Biscay, but not yet from the Indian Seas. In Japan it has been recorded from the warm currents.

Genus *Ctenocalanus* GIESBRECHT, 1888

The genus comprises only one species, *Ctenocalanus vanus* GIESBRECHT. The genus is closely allied to *Clausocalanus*, but is easily distinguished from the former by the ctenate form of the outer edge spine on the 3rd joint of the exopodite of 3rd and 4th leg. In the male the 1st leg has an outer-edge spine only on the terminal joint of the exopodite. *Ctenocalanus longicornis* described by MORI appears to be a synonym of *C. vanus* GIESBRECHT.

Ctenocalanus vanus GIESBRECHT

Ctenocalanus vanus GIESBRECHT, 1892, p. 194, t. 10, 36; ESTERLY, 1924, p. 90; FARRAN, 1929, p. 226; FARRAN, 1936, p. 85; TANAKA, 1937, p. 253; *C. longicornis* MORI, 1937, p. 37, pl. 15.

Length. Female, 1.18–1.27 mm. Male, 1.25–1.40 mm.

Remarks. MORI reported a specimen which has no 5th pair of legs from Japanese waters. The immature male has 4-jointed abdomen; the ctenate outer marginal spines are found in the 3rd and 4th legs; they measured 1.09–1.14 mm.

Occurrence. The species has been collected both from the surface and deep waters, but it is rather abundant in the deep layers.

Distribution. The species is widely distributed in the warm and temperate regions of the Pacific, Atlantic, Red Sea, Mediterranean Sea, San Francisco Bay, La Jolla and also from the Antarctic region, but not from the Indian and Malayan regions.

Genus *Pseudocalanus* BOECK, 1872

Two species have been recorded from the Japanese waters: *Pseudocalanus minutus* (KRÖYER) and *P. gracilis* SARS. One of them appeared in the collection; the species is the inhabitant of northern cold waters.

Pseudocalanus minutus (KRÖYER)

Pseudocalanus elongatus GIESBRECHT, 1892, p. 197, t. 10; SARS, 1908, p 20; SATO, 1913, p. 18; *P. minutus* WITH, 1915, p. 57; WILSON, 1932, p. 43; MORI, 1937, p. 36, pl. 15.

Length. Male, 1.30 mm.

Occurrence. A single male specimen was obtained in a vertical haul from the depth 1000 m to the surface in Sagami Bay, Nov., 1937.

Distribution. The species has a wide distribution in the temperate waters of the North Pacific and Atlantic. It has not been recorded from the Indian Seas.

Genus *Microcalanus* G.O. SARS, 1901

The genus was created by SARS to accomodate a small Calanoid, taken in the Norwegian coast, named *Microcalanus pusillus*; then he added the second species, *M. pygmaeus*, which had been described as *Pseudocalanus pygmaeus*, taken in the NANSEN's North Polar Expedition. These two species resemble so closely each other that the distinction between them is very unclear. The generic characters are as follows: the head fused with the 1st thoracic segment, so the 4th with the 5th; the rostrum small; the abdomen 4-jointed; the furca small; the 1st antenna 24-jointed; the oral parts as in *Pseudocalanus* except the slender maxillipede; the swimming legs as in *Pseudocalanus*; the 5th legs absent in the female; the male 5th legs asymmetrical, 6-jointed on the left side.

One species belonging to the genus was found from the intermediate layer of Sagami Bay.

Microcalanus pygmaeus G.O. SARS

(Fig. 12, *a–f*)

Microcalanus pygmaeus GIESBRECHT, 1902, p. 000; *M. pusillus* WOLFENDEN, 1911, p. 000; *M. pygmaeus* WITH, 1915, p. 66; FARRAN, 1929, p. 226; JESPERSEN, 1934, p. 50.

Female. Length, 0.85 mm, cephalothorax 0.64 mm, abdomen 0.21 mm; the abdomen is contained 2.9-times in the length of the cephalothorax. The cephalothorax ovate; the greatest width about half the length of the cephalothorax. The head fused with the 1st thoracic segment; the last two thoracic segments are fused; the lateral corners of the last thoracic segment narrowly rounded at the apex. The rostrum pointed, directs slightly posteriorly. The abdomen 4-jointed; the segments and furca in the proportions 37 : 21 : 17 : 17 : 8 = 100; the genital segment rounded, about as long as wide, and produced considerably below; the furcal rami slightly longer than wide.

The 1st antenna 24-jointed, extends at least to the distal margin of the 3rd abdominal segment. The 2nd antenna has the exopodite longer than the endopodite (15 : 11); the 2nd joint of the exopodite has three setae; the 3rd has one seta. The mandible has the exopodite slightly shorter than the endopodite (4 : 5). The Maxilla and maxillipede are as those of *M. pusillus* illustrated by G. O. SARS.

In the 1st leg the outer marginal spines on the 2nd and 3rd joints long and curved inwards. In the 2nd leg the terminal spine of the exopodite about as long as

the combined lengths of the three joints of the exopodite taken together, and has 27 serrations; in the GIESBRECHT's specimen the number of the serration is about 40. The terminal spine of the exopodite of the 3rd leg broken off. The 4th leg abnormal: the exopodite 2-jointed, the 2nd basal joint has spinules on the distal inner margin at the base of the endopodite.

Remarks. The specimen, though resembles closely *M. pusillus*, differs from it in the length of the terminal spine, and the number of serration on the exopodite of the 2nd leg. *M. pygmaeus*, taken from the Antarctic, has comparatively long 1st antenna extending to the anterior margin of the anal segment and has the terminal spines of

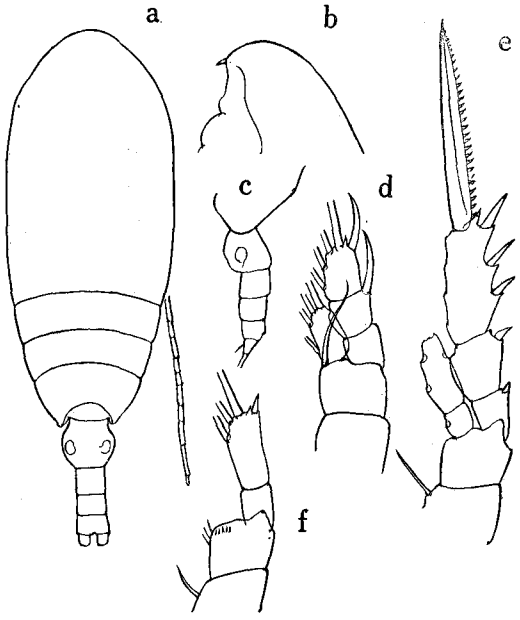

Fig. 12. *Microcalanus pygmaeus* G. O. SARS.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, 1st leg; *e*, 2nd leg; *f*, abnormal 4th leg.

the exopodite of the 2nd to 4th legs longer and more finely toothed when compared with those of *M. pusillus* which has only 16 teeth on the terminal spine of the 2nd leg. *M. pygmaeus* was originally described by Sars from the specimen taken in the Arctic region. GIESBRECHT described the same species taken from the Antarctic regions. According to WOLFENDEN *M. pygmaeus* described by GIESBRECHT is not identical with *M. pygmaeus* G. O. SARS, but identical with *M. pusillus* G. O. SARS. SARS stated in his description that in *M. pusillus* the 1st antenna is much shorter than that of *M. pygmaeus*, scarcely extending beyond the end of the genital segment; the swimming legs of *M. pusillus* are less slender than those of *M. pygmaeus*; the terminal

joint of the exopodite of the 2nd to 4th legs comparatively broader, and has the apical spine remarkably dilated, cultrate in shape, and very coarsely serrated. The present specimen agrees more closely with the Antarctic specimen of *M. pygmaeus*, described by GIESBRECHT or FARRAN in the structure of the swimming legs than with *M. pusillus* G. O. SARS.

Occurrence. One female in the vertical haul from the depth 500 m to 300 m, in Sagami Bay.

Distribution. The species has a bipolar-epiplanktonic distribution. It has been recorded from the Arctic regions by G. O. SARS, WITH and JESPERSEN. From the Antarctic it has been reported by GIESBRECHT, WOLFENDEN and FARRAN. The species has not yet been recorded from the Indian and Malayan regions.

Genus *Mimocalanus* FARRAN, 1908

The genus was created by FARRAN to accomodate a number of species closely related to *Spinocalanus*. FARRAN described two species belonging to the genus, namely *Mimocalanus cultrifer* and *M. nudus*, one of which appeared in the collection. The genus is characterised by the followings: absence of rostral filament; the separation of the last two thoracic segments; the equal branches of the 2nd antenna; the large two-branched palp of the mandible, of which the inner being longer than the outer; the maxillae and maxillipede being of *Paracalanus* type; the 1st to 4th legs with jointing and setae as in *Spinocalanus* except that the outer-edge spine on the 1st joint of the exopodite of the 1st leg is absent; the terminal spine of the exopodite of the 2nd to 4th legs are of cultrate form; no spinules on the faces of the legs; the 5th leg absent in the female; the male 5th legs 5-jointed on left side, 4-jointed on the right.

Mimocalanus cultrifer FARRAN

(Fig. 13, *a–i*)

Mimocalanus cultrifer FARRAN, 1908, p. 23, pl. 1; FARRAN, 1926, p. 244; VERVOORT, 1947, p. 156.

Female. Length, 1.50 mm; cephalothorax, 1.11 mm, abdomen, 0.29 mm; the cephalothorax oblong ovate in dorsal view, contracts anteriorly and the frontal margin is vaulted; the head fused with the 1st thoracic segment; the last two thoracic segments separate, but the line of suture very faintly detectable; the lateral corners of the last thoracic segment narrowly rounded at the apex; the rostrum absent. The abdomen 4-jointed, contained 4-times in the length on the cephalothorax; the segments and furca in the proportions 49 : 16 : 13 : 19 : 13=100; the genital segment about as long wide and moderately produced ventrally; the furcal rami as long as wide.

The 1st antenna 24-jointed, exceeds the distal margin of the furca by last one or two joints; the proportional lengths of the joints measured along the posterior margin

as follows:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	47	35	18	18	23	23	23	52	35	35	41	47	52	52	52	52
	18	19	20	21	22	23	24	25								
	52	58	52	47	52	52	47	35 = 1000;								

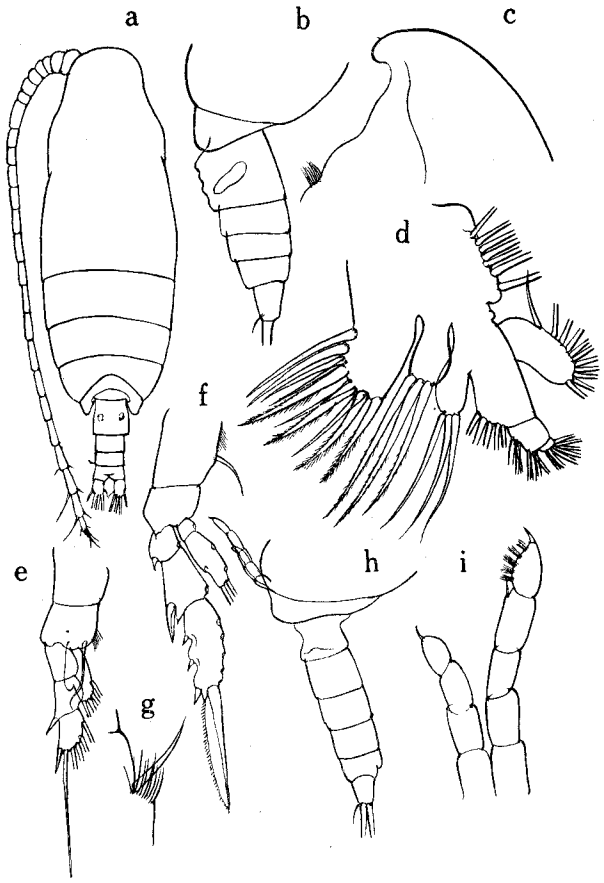

Fig. 13. *Mimocalanus cultrifer* FARRAN.
a, Female: dorsal aspect; *b*, last thoracic segment and abdomen, lateral aspect; *c*, head, lateral aspect; *d*, 1st maxilla; *e*, 1st leg; *f*, 2nd leg; *g*, 1st basal joint of 4th leg; *h*, Male: last thoracic segment and abdomen, lateral aspect; *i*, 5th pair of legs.

the joints 8 and 9 are incompletely fused; the joints 10 and 11 are slightly inflated. The 2nd antenna with the exopodite about as long as the endopodite; the 1st and 2nd joints of the exopodite has 9 marginal setae. The mandible has the exopodite slightly shorter than the endopodite. The 1st maxilla slightly differs from that described by FARRAN; the outer lobe has 7 setae, of which the proximal one is short;

the exopodite has 11 setae; the endopodite has 7+4+3 setae; the 2nd basal joint has 5 setae; the 3rd inner lobe has 3, the 2nd lobe has 4, the 1st lobe has 10 setae; the setae on the inner lobes are strong. The 2nd maxilla has 6 setae in all on the joints of the endopodite, but they are unmodified. In the maxillipede the combined lengths of the joints of the endopodite much longer than the 1st basal joint; the 2nd basal joint short.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the 1st joint of the exopodite has no outer-edge spine. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the outer-edge spine on the 2nd joint of the exopodite is the longest; the terminal spine of the exopodite finely serrated; the 3rd joint of the exopodite has 5 inner marginal setae. The 3rd and 4th legs have each 3-jointed exopodite and endopodite. The 4th leg has a row of stiff hairs on the inner margin of the 1st basal joint at the base of the inner marginal seta.

Male. Length, 1.28 mm; cephalothorax 0.98 mm, abdomen 0.3 mm. The general appearance as those of the female. The abdomen 5-jointed, and is contained 3.25-times in the length of the cephalothorax; the segments and furca in the proportions 19 : 18 : 18 : 15 : 18 : 12=100.

The 1st antenna exceeds the end of the furca by last two joints. Mouth parts and the swimming legs as those of the female.

The 5th pair of legs asymmetrical: the right side 4-jointed, the left side 5-jointed; the distal joint has hairs on the inner margin.

Remarks. The specimens agree fairly well with *M. cultrifer* which FARRAN collected from the Irish Atlantic Slope.

Occurrence. Two females and a male from Sagami Bay in the vertical haul from the depth 500 to 300 m, Nov., 1937.

Distribution. The species has only been recorded from the deep water of the Irish Atlantic Slope, but its geographical distribution is extended to the Celebes Sea in the Snellius Expedition.

Genus *Spinocalanus* GIESBRECHT, 1888

There has only one species of the genus *Spinocalanus* been known in the Japanese waters, namely *Spinocalanus abyssalis* from the deep water of Suruga Bay. The present collection added four more species: *Spinocalanus spinosus* FARRAN, *S. magnus* WOLFENDEN *S. angusticeps* G. O. SARS and *S. longipes.* The last species has not yet been described, and I propose a new name *longipes.*

Spinocalanus abyssalis GIESBRECHT

Spinocalanus abyssalis GIESBRECHT, 1892, p. 209, t. 13, 36; SARS, 1903, p. 22, 157; WITH, 1915, p. 69; FARRAN, 1926, p. 242; FARRAN, 1929, p. 227; JESPERSEN, 1934, p. 51; TANAKA, 1937, p. 253, fig. 4; VERVOORT, 1947, p. 147.

Remarks. The Atlantic specimen of *S. abyssalis* varies in size from 0.95 to 1.86 mm. FARRAN proposed a new variety name, var. *pygmaeus*, for the small form measuring 0.95–1.1 mm. GIESBRECHT's specimens measured 1.1–1.25 mm ; WITH's 1.73–1.86 mm ; FARRAN's 0.95–1.86 mm ; my specimen 1.01–1.93 mm.

Occurrence. Both size groups occurred commonly in the waters below 200 m.

Distribution. According to FARRAN the small form is less than half as plentiful as the large form above 300 fathoms, but below that depth it becomes much more numerous. *S. abyssalis* has been said to be of Arctic origin, and widely distributed in the deep waters of the oceans but it has not been recorded from the Indian and Malayan regions.

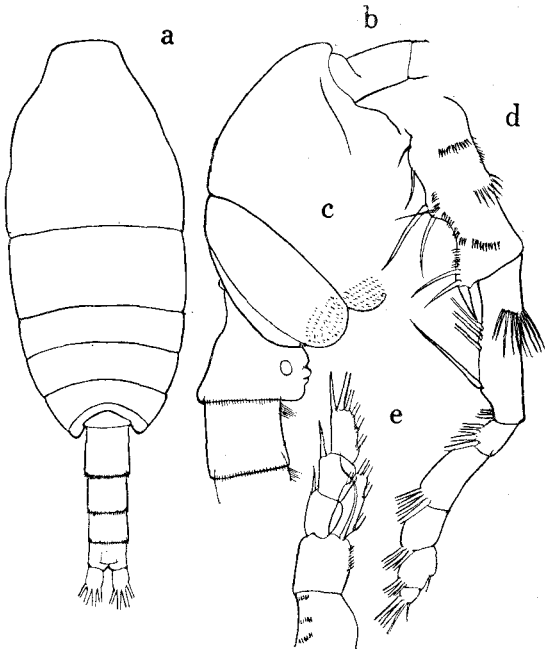

Fig. 14. *Spinocalanus spinosus* FARRAN.
a, Female : dorsal aspect ; *b*, head, lateral aspect ; *c*, last thoracic segment and genital segment, lateral aspect ; *d*, maxillipede ; *e*, 1st leg.

Spinocalanus spinosus FARRAN

(Fig. 14, *a–e*)

Spinocalanus spinosus FARRAN, 1908, p. 27 ; *Spinocalanus horridus* WOLFENDEN, 1911, p. 216 ; *S. spinosus* FARRAN, 1929, p. 227 ; VERVOORT, 1947, p. 153.

Female. Length, 2.47 mm ; cephalothorax, 1.70 mm, abdomen, 0.77 mm. The head separates from the 1st thoracic segment ; the last two thoracic segments are fused ;

the lateral corners of the last thoracic segment rounded; the lateral face of the thoracic segments are finely spinulose; the rostrum absent.

The abdominal segments and furca in the proportions 28 : 21 : 21 : 16 : 14 = 100; the genital segment about as long as wide; the ventral surface of the segment has irregular swellings on the genital area; the 2nd and 3rd gegments hirsute on the proximal margin on the ventral surface; the furcal rami about 1.3-times as long as wide.

The 1st antenna exceeds the end of the furca by distal four joints. The 2nd antenna with the exopodite 1.5-times as long as the endopodite. The mandible hirsute on the 2nd basal joint. The maxilla and maxillipede as those of *S. abyssalis*, but the 1st basal joint of the maxillipede has a row of long spines which is entirely absent in *S. abyssalis*, about the middle of the posterior margin.

The swimming legs have general resemblance to those of *S. abyssalis*.

Remarks. According to FARRAN the size of the animal varies from 1.85 to 2.0 mm in the West coast of the Ireland, and 2.13 to 2.45 mm in the Antarctic. WOLENDEN's *S. horridus* is identical with *S. spinosus*, which measured 2.35 mm in total length.

Occurrence. Ten females were taken in Sagami Bay, Nov. 1937, from the depth 1200–0 m.

Distribution. The species has been recorded from the West Coast of Ireland, Bay of Biscay, and Antarctic. The species has a fairly wide distribution in the deep waters of the oceans.

Spinocalanus magnus WOLFENDEN

(Fig. 15, *a–g*)

Spinocalanus magnus FARRAN, 1908, p. 27; WOLFENDEN, 1911, p. 216; G. O. SARS, 1925, p. 33; FARRAN, 1929, p. 227; SEWELL, 1929, p. 95; JESPERSEN, 1934, p. 52; VERVOORT, 1947, p. 150.

Female. Length, 2.50 mm; cephalothorax, 2.00 mm. The cephalothorax elongate ovate; the last thoracic segment not produced as that figured by G. O. SARS. The abdomen 4-segmented, the segments and furca in the proportions 36 : 14 : 11 : 18 : 21 = 100; the genital segment produced below; the genital part has irregular swellings; the furcal rami 1.5-times as long as wide.

The 1st antenna were broken off in all specimens. The 2nd antenna has the exopodite about as long as the endopodite; the other mouth parts as described by WOLFENDEN.

In the 1st leg the 2nd basal joint has several spinules on the inner distal margin. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite, the 2nd and 3rd joints of the exopodite, and the 2nd joint of the endopodite are each furnished with a row of spinules. The 3rd and 4th legs have each 3-jointed exopodite and endopodite. The 5th leg absent.

Male. Length, 2.13 mm. The general appearance as in the female. The abdomen is contained 2.7-times in the length of the cephalothorax; the abdomen 5-segmented, the segments and furca in the proportions 15 : 19 : 14 : 21 : 10 : 21 = 100; the furcal rami 2-times as long as wide. The 1st antenna reaches back to the end of the furca. The 1st to 4th legs as those of the female. The 5th pair of legs have 3-jointed exopodite and 2-jointed endopodite on each side.

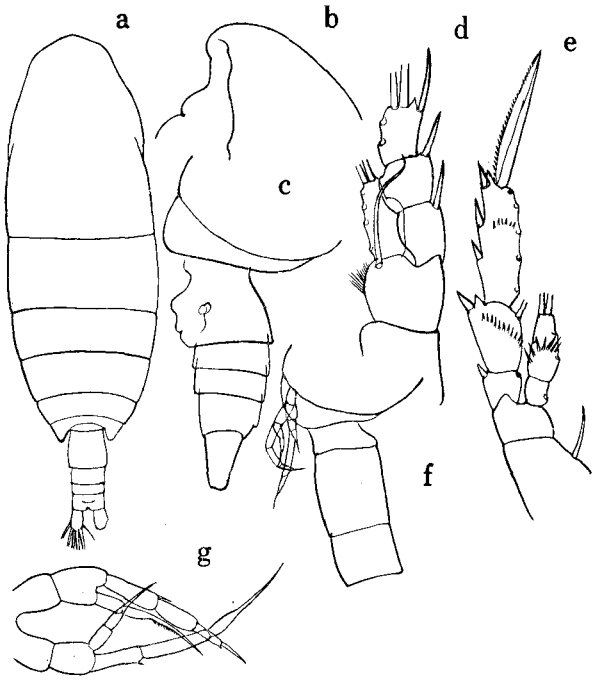

Fig. 15. *Spinocalanus magnus* WOLFENDEN.
a, Female: dorsal aspect; *b*, head. lateral aspet; *c*, last thoracic segment and abdomen, lateral aspect; *d*, 1st leg; *e*, 2nd leg; *f*, Male: last thoracic segment and abdominal segments, lateral aspect; *g*, 5th pair of legs.

Occurrence. Seven females and one male from the depth 1000 m to the surface in both Sagami and Suruga Bay.

Distribution. It has been recorded from the deep waters of the Pacific, Atlantic and Indian Oceans.

Spinocalanus angusticeps G. O. SARS

(Fig. 16, *a–f*)

Spinocalanus angusticeps SARS, 1920, p. 3; G. O. SARS, 1925.

Female. Length, 2.33 mm; cephalothorax, 1.86 mm; abdomen, 0.47 mm. The head separates from the 1st thiracic segment; the last two thoracic segments separate. The head contracts laterally in front when viewed from the dorsal. The lateral corners of the last thoracic segment rounded. The rostrum absent.

The abdomen 4-jointed, contained 4-times in the length of the cephalothorax; the segments and furca in the proportions 37 : 19 : 16 : 14 : 14 = 100; the genital segment produced rectangularly below; the furcal rami slightly wider than long; the 1st to 3rd segments are furnished with fine teeth on the distal margin.

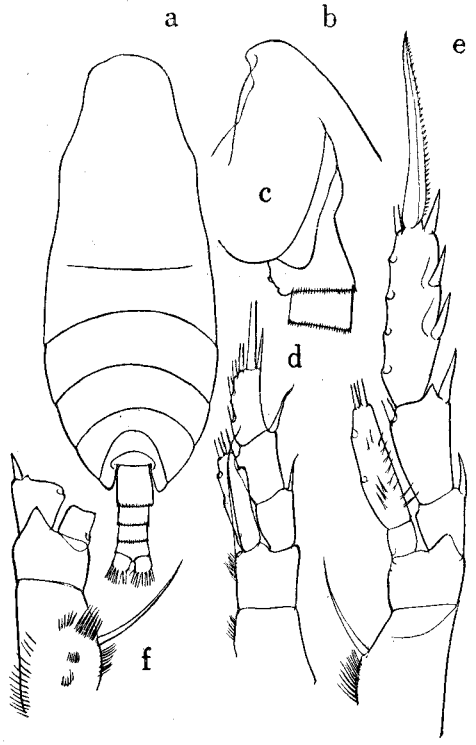

Fig. 16. *Spinocalanus angusticeps* G. O. SARS.
a, Female; dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and gehital segment, lateral aspect; *d*, 1st leg; *e*, 2nd leg; *f*, basal joints of 4th leg.

The 1st antenna broken off in the distal part; the 2nd joint is very long, about 3-times as long as the 3rd. The 2nd antenna has the exopodite shorter than the endopodite (30 : 35). The mandible has the exopodite about as long as the endopodite. The 1st maxilla has a large exopodite, carrying nine setae; the endopodite small; the outer lobe has nine setae. The 2nd maxilla without any noticeable feature. The maxillipede has a long endopodite resembling that of *S. abyssalis*.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the 2nd joint of the endopodite is furnished with spines on the posterior surface. The 3rd and 4th legs have each 3-jointed endopodite; the 2nd and 3rd joint of the endopodite are furnished with spinules on the posterior surface; the 1st basal joint is furnished with hairs as shown in the figure.

Remarks. The species is easily recognised by the peculiar shape of the head.

Occurrence. Three females in the vertical hauls from the depth 1000 m to the surface in Sagami, Nov., 1937.

Distribution. The species has been recorded from the temperate region of the Atlantic near the Azores Islands.

Spinocalanus longipes sp. nov.

(Fig. 17, *a-f*)

Male. Length, 1.59 mm; cephalothorax, 1.16 mm; abdomen, 0.43 mm; so the abdomen is contained 2.7-times in the length of the cephalothorax. The head separates from the 1st thoracic setment, and the 4th incompletely from the 5th. The last thoracic segment slightly emarginate on the postero-lateral corners. The rostral filament absent. The abdomen 5-segmented; the segments and furca in the proportions 10 : 31 : 22 : 21 : 6 : 10 = 100; the furcal rami slightly longer than wide (5 : 4).

The 1st antennae extend about to the distal margin of the abdominal segment; the right antenna 22-jointed, the joints 8-9-10, 20-21 are fused; the left antenna 23-jointed, the joints 20 and 21 are separate; joints of the antenna measured along the posterior margin are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9-10	11	12	13	14	15	16	17
	71	54	24	30	30	30	30	95	29	36	35	35	42	48	47

	18	19	20	21	22	23	24	25
	54	54	47	36	48	47	54	24 = 1000

The 2nd antenna has the exopodite 1.25 times as long as the endopodite. The mandible has a robust and round 2nd basal joint; the exopodite about as long as the endopodite. The maxillae reduced. The maxillipede resembles that of *S. abyssalis*; the 2nd joint of the endopodite is long; the 5th joint comparatively large, and carries two long setae and two short ones.

The 1st leg with 3-jointed exopodite and 1-jointed endopodite. The 2nd to 4th legs broken off; the basal joints are furnished with spinules.

The left 5th leg is long and slender, it is much longer than the combined length of the abdominal segments and furca, the 2nd basal joint has a rudimentary endopodite; the right leg short, about as long as the 1st basal joint of the left leg.

Remarks. Although the swimming legs which is the important character of the genus were broken off, the absence of the rostrum, and the features of the joints of the maxilliped, may indicate that the specimen belongs clearly to the genus *Spinocalanus*. The 5th pair of legs are quite different from those hitherto been described and figured.

Occurrence. One male in the vertical haul from the depth 1000 m to the surface in Sagami, Nov., 1937.

Fig. 17. *Spinocalanus longipes* sp. now.
a, Male: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; d, 1st maxilla; *e*, 2nd maxilla; *f*, maxillipede.

Genus *Monacilla* G. O. SARS, 1905

G. O. SARS described in 1905 a new species of Calanoida under the name *Monacilla typica*. FARRAN (1908) described *Oxycalanus spinifer* which is congeneric with the former. In 1909 A. SCOTT described two species *Oxycalanus semispinus* and *Monacilla dubia*. But according to SARS these two species are two sexes of *Monacilla typica*. In the present collection two species were collected, namely *Monacilla typica* G.O. SARS

and *M. gracilis* WOLFENDEN. The genus has the following characters: the head fused with the 1st thoracic segment, and so are the 4th with the 5th; the rostrum consists of two strong spines, directing ventrally; the abdomen 4-jointed; the 1st antenna 23-jointed, the joints 8 and 9, 24 and 25 are fused; the 2nd antenna, maxilla and maxillipede are of *Pseudocalanus* type; the 1st to 4th legs as in *Spinocalanus*; the distal joint of the endopodite of the 2nd to 4th legs has 5, 6, 6 setae respecitively; in this the genus is closely related to *Spinocalanus* but, the spinulation on the faces of the joints are reduced than in *Spinocalanus*; the 5th leg absent in the female, in the male 5th legs 5-jointed on each side and uniramose.

Monacilla typica G. O. SARS

(Fig. 18, *a–h*)

Monacilla typica SARS, 1905, p. 9; *Oxycalanus spinifer* FARRAN, 1908, p. 35; *O. semispinus* A. SCOTT, 1909, p. 35; *Monacilla typica* G. O. SARS, 1925, p. 38; VERVOORT, 1947, p. 158.

Female. Lengh, 2.25 mm; cephalothorax, 1.77 mm, abdomen, 0.48 mm. The cephalothorax oblong ovate; the head separates from the 1st thoracic segment; the last two thoracic segments fused; last thoracic segment slightly asymmetrical; the lateral corners of the segment rounded, and slightly produced posteriorly; the rostrum produced into well defined sharp point.

The abdomen 4-jointed, the segment and furca in the proportional lengths 40 : 16 : 15 : 11 : 18=100; the genital segment aymmetrical: the right side is slightly swollen, there is a protuberance on the ventral surface of the right side; the furcal rami 1.7-time as long as wide, the outermost seta is short, this is not figured by SARS.

The 1st antenna 24-jointed, reaches back to the distal margin of the 3rd abdominal segment. The 2nd antenna, mandible and maxilla as figured by SARS. The maxillipede has a transverse row of spinules on the posterior margin about the middle of the 1st basal joint as illustrated by A. SCOTT.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the outer margin of the 1st has basal joint has groups of stiff hairs. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the 2nd joint of the endopodite has two rows of spinules; the 1st basal joint is furnished with spinules; the terminal spine of the exopodite finely serrated. The 3rd leg has 3-jointed exopodite and endopodite; the 2nd and 3rd joints of the exopodite and endopodite are furnished with rows of spinules. The 4th leg has 3-jointed exopodite and endopodite; the 2nd and 3rd joints of the exopodite and endopodite are furnished with groups of spinules as shown in the figure; the 1st basal joint has a transverse row of long acicular spines on the posterior surface about the middle of the joint only on the left side; the acicular spines not extend beyond the distal margin of the 1st basal joint; the terminal spine of the exopodite is coarsely serrated.

Remarks. The present specimen agrees well with the description and figures given by several authors except that the head and 1st thoracic segment are separate.

Occurrence. Twenty five females in Sagami and Suruga Bay, from the depth 1000 m to the surface.

Distribution. The species has a wide distribution in the Atlantic, Pacific and Indian Oceans.

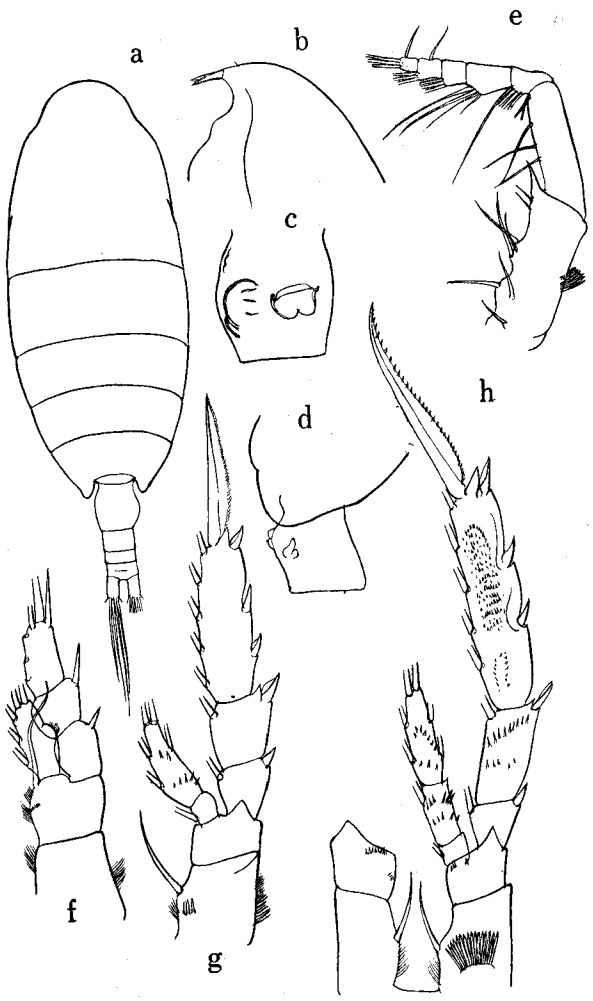

Fig. 18. *Monacilla typica* G. O. SARS.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, genital, ventral aspect; *d*, last thoracic segment and genital segment, lateral aspect; *e*, maxillipede; *f*, 1st leg; *g*, 2nd leg; *h*, 4th legs.

Monacilla typica var. *asymmetrica*, var. nov.

(Fig. 19 *a*)

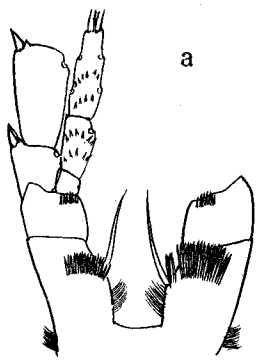

Fig. 19. *Monacilla typica* var. *asymmdtrica*, var. nov. *a*, Female: 4th legs.

Female. Length, 2.27 mm; cephalothorax, 1.77 mm; abdomen, 0.50 mm. The specimen agrees quite well with *M. typica* SARS except that there is a transverse row of short and slender acicular spines on the posterior surface of the 1st basal joint of the right 4th leg; the specimen may be referred to *M. gracilis* WOLFENDEN in having acicular spines on either side of the 1st basal joint of the 4th leg; but the shape of the genital segment differs from that of *M. gracilis*; the genital segment has a swelling on the right side as in *M. typica*, but the protuberance on the right side of the genital orfice is absent.

Occurrence. Two females from Sagami Bay in the vertical hauls from the depth 1000 m to the surface.

Monacilla gracilis (WOLFENDEN)

(Fig. 20, *a–c*)

Oxycalanus gracilis WOLFENDEN, 1911, p. 221.

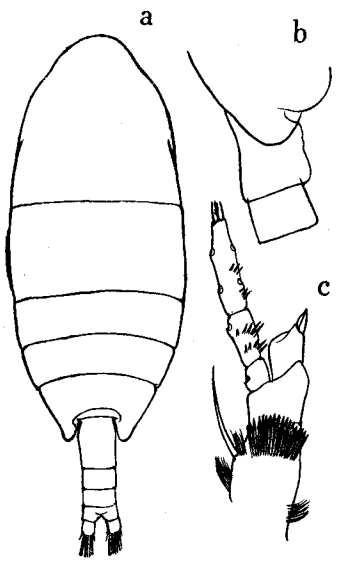

Fig. 20. *Monacilla gracilis* WOLFNDEN. *a*, Female: dorsal aspect; *b*, last thoracic segment and genital segment, lateral aspect; *c*, 4th leg.

Female. Length, 2.25 mm; cephalothorax, 1.75 mm; abdomen, 0.50 mm. The general appearance as in *M. typica*; the abdomen 4-segmented, the segments and furca in the proportional lengths 38 : 17 : 17 : 14 : 14=100; the genital segment symmetrical, not produced below as in *M. typica*; the furcal rami 1.3-times as long as wide.

The 1st antenna slightly exceeds the end of the furca when pressed against the body. The 2nd antenna has the exopodite as long as the endopodite. The mandible has the exopodite as long as the endopodite. The 1st maxilla has the following spinulation; the outer lobe, 9; the exopodite, 11; the endopodite, 6, 5, 4; the 2nd basal, 5; the 3rd inner lobe, 4; the 2nd inner lobe, 5; the 1st inner lobe, 14 setae. The 2nd maxilla and maxillipede have no interesting feature.

The 1st to 3rd swimming legs are as those of the foregoing species. The 4th pair of legs symmetrical; the transverse row of acicular spines exceeds

the distal margin of the 1st basal joint of the legs; the number of acicular spines about 18.

Remarks. The specimen, though larger in size, agrees fairly well with the WOLFENDEN's examples collected from the deep waters of the tropical Atlantic in Südpolar-Expedition. The species, though closely resembles *M. typica*, differs from it in the shape of the genital segment, and in having acicular spines on the 1st basal joint of the 4th pair of legs.

Occurrence. One adult female from Sagami in the vertical haul 1000 m to the surface, Nov., 1937.

Genus *Drepanopsis* WORFENDEN, 1911

The genus was created by WOLFENDEN. At present it comprises only one species, *Drepanopsis frigidus*, taken from the Antarctic region. The generic characters are as follows: head fused with the 1st thoracic segment; last two thoracic segments are separate; rostrum or rostral filments absent; 1st antenna 24-jointed, the joints are very setose; 2nd antenna with the endopodite longer than the exopodite; mandible with a small endopodite; 1st and 2nd maxillae and maxillipede are of *Paracalanus*-type; 1st to 4th legs as those of *Spinocalanus*, but the number of spines on the faces of the joints much reduced; 5th pair of legs 3-jointed, with two apical setae. The genus *Farrania* created by SARS is identical with *Drepanopsis* WOLFENDEN. The presence of four setae on the 3rd joint of the exopodite of the 2nd and 3rd legs indicate that the genus *Farrania* is not allied to the genus *Spinocalanus*, but to *Clausocalanus* or *Pseudocalanus*.

Drepanopsis frigidus WOLFENDEN

(Fig. 21, *a–k*)

Drepanopsis frigidus WOLFENDEN, 1911, p. 245; FARRAN, 1929, p. 232; SEWELL, 1929, p. 96; VERVOORT, 1951, p. 61, figs. 34–39.

Female. Length, 2.88–2.95 mm. The body oblong ovate in dorsal view. The head fused with the 1st thoracic segment, the 4th thoracic segment separates from the 5th; the lateral corners of the last thoracic segment produced triangularly, but the apex is not so sharp as figured by WOLFENDEN. The rostrum is represented by two small points when viewed from the ventral.

The abdomen 4-segmented and is contained about 6-times in the length of the cephalothorax; the segment and the furca in the proportions 42 : 8 : 8 : 13 : 29=100; the genital segment 1.4-times as wide as long, and produced considerably below; the first three segments are fringed with very minute teeth on the distal margin; the furcal rami 1.5-times as long as wide.

The 1st antenna 24-jointed, reaches back to the end of the 3rd abdominal segment;

the joints measured along the posterior margin are in the following proportions:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	31	55	27	31	31	31	34	55	31	34	34	48	52	55	52	51
	18	19	20	21	22	23	24	25								
	51	51	41	34	48	52	45	27 = 1000;								

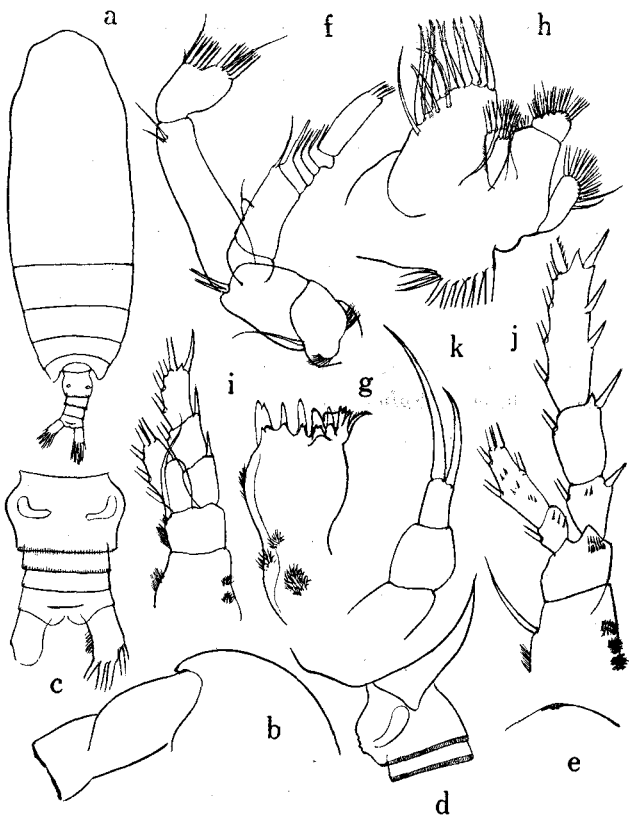

Fig. 21. *Drepanopsis frigidus* WOLFENDEN.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, abdomen, dorsal aspect; *d*, last thoracic segment and genital segment, lateral aspect; *e*, rostrum, ventral aspect; *f*, 2nd antenna; *g*, mandible blade; *h*, 1st maxillia; *i*, 1st leg; *j*, 2nd leg; *k*, 4th leg.

the joints are furnished with slender setae. The 2nd antenna has the exopodite about as long as the endopodite; the 2nd joint of the exopodite has two protuberances which carry each a short marginal seta. The mandible has a small endopodite; the biting part is furnished with groups of fine spinules. The 1st maxilla has the following spinulation: the outer lobe has 9 setae, the exopodite 11 setae, the endopodite 4, 4, 6 setae. The 2nd maxilla has a row of spinules on the 2nd and 3rd lobe; the setae

arising from the endopodite are unmodified. The maxillipede as shown in the figure; the basal joints are furnished with rows of spinules on the anterior margin.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the 1st basal joint has two groups of spinules on the outer margin. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the 1st and 2nd joints of the endopodite are furnished with spinules on the posterior surface; the terminal spine of the exopodite has 29 serrations. The 3rd and 4th leg have each 3-jointed exopodite and endopodite; the joints of the endopodite are furnished with groups of spinules on the posterior surface; the terminal spine of the exopodite has 28 and 43 serrations respectively. The 5th pair of legs 3-jointed; the distal joint has two spines; the inner one is about as long as the combined lengths of the three joints taken together.

Remarks. The specimen agrees well with the description given by WOLFENDEN. FARRAN's specimen from the Antarctic has the total length 2.58–2.88 mm; SEWELL's specimen from the Indian Seas measured 2.28 mm, and has a backwardly pointing median spine instead of bifid rostrum. VERVOORT's specimen from the Antarctic measured 2.90 mm, and has a rostral median spine. The present specimen agrees quite well with those described except the stupid rostrum and longer abdomen and 1st antenna.

Drepanopsis orbus sp. nov.

(Fig. 22, *a–k*)

Female. Length, 3.56 mm; cephalothorax, 2.79 mm; abdomen, 0.77 mm; the cephalothorax elongate ovate; the head separates from the 1st thoracic segment; the 4th and 5th thoracic segments are incompletely separate; the lateral corners of the last thoracic segments are produced into sharp points; the rostrum absent.

The abdomen 4-jointed; the segments and furca in the proportions: 38 : 18 : 16 : 15 : 13 = 100; the genital segment as long as wide; the furcal rami as long as wide; the outer-marginal seta of the furca slender and short; the first three abdominal segments are furnished with fine spinules on the distal margin.

The 1st antenna 24-jointed, extends to the distal margin of the genital segment, the joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	58	81	38	35	38	35	36	55	32	32	35	46	49	49	49	49
	18	19	20	21	22	23	24	25								
	46	46	38	38	32	35	32	17 = 1000;								

the setae on the joints are slender as in *D. frigidus*. The 2nd antenna has the exopodite about as long as the endopodite (42 : 44); the 2nd joint of the exopodite has three prominences on the anterior margin, and they carry each a seta; the 1st basal has a row of hairs. The mandible as those of *D. frigidus*. The 1st maxilla has the

following spinulation on the various parts: the outer lobe has 7 long and 2 short setae; the exopodite is very small, carries 11 setae; the endopodite has 7, 5, 4 setae; the 2nd basal joint has 5 setae; the 3rd and 2nd inner lobe have each 4 setae; the 1st inner lobe has 14 setae. The 2nd maxilla as that of *D. frigidus*. The maxillipede robust, and in the main features resembles that of *D. frigidus*.

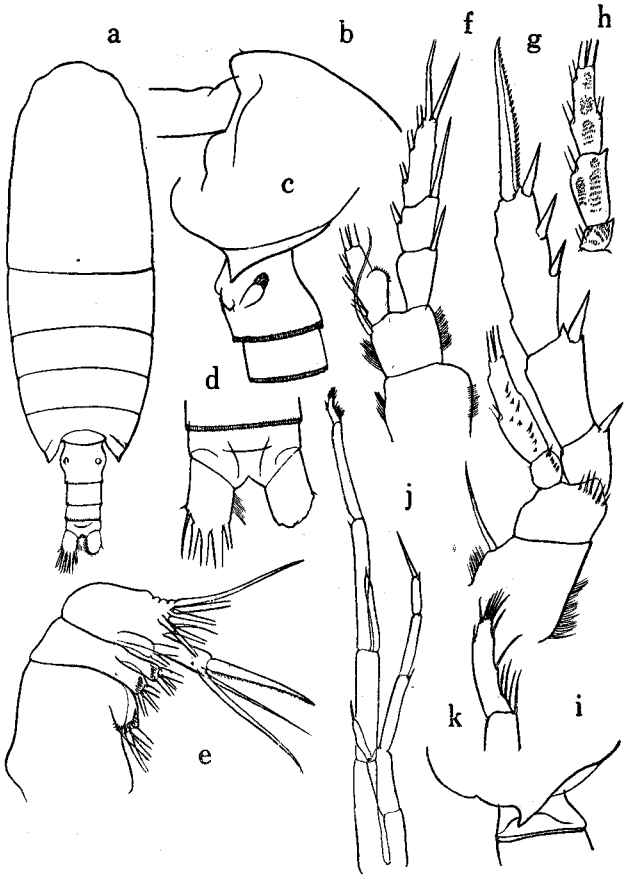

Fig. 22. *Drepanopsis orbus* sp. nov.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, anal segment and furca, dorsal aspect; *e*, maxillipede; *f*, 1st leg; *g*, 2nd leg; *h*, endopodite of 4th leg; *i*, Male: last thoracic segment and genital segment; *j*, 5th pair of legs; *k*, terminal joint of right 5th leg.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the joints of the endopodite slender; the outer-edge spines of the exopodite long, there is a small protuberance on the outer margin about one-third of the terminal joint of the exopodite; the 1st basal joint protuberates on the outer distal corner. The 2nd leg has

3-jointed exopodite and 2-jointed endopodite; the 1st basal joint is furnished with stiff hairs on the outer and also in the inner margin; the 2nd basal joint has a row of spines near the junction with the exopodite; the endopodite has a group of spines on the 1st joint, and three groups of spines on the 2nd joint; the terminal spine of the exopodite has 39 serrations. The 3rd leg has 3-jointed exopodite and endopodite, and has similar features as those of the 2nd leg; the terminal spine of the exopodite has 34 serrations. The 4th leg has 3-jointed exopodite and endopodite; there is no stiff hair on the outer margin of the 1st basal joint, and no row of spine on the 2nd basal joint; the endopodite is furnished with very minute spinules on the posterior surface; the terminal spine has 42 serrations. The 5th leg entirely absent.

Male. Length, 3.01 mm; cephalothorax, 2.30 mm, abdomen, 0.71 mm; the general appearance as in the female. The abdomen 5-segmented, the segments and fruca in the proportional lengths: 13 : 26 : 20 : 23 : 3 : 15 = 100: the furcal rami about 1.3-times as long as wide.

The 1st antenna 21-jointed, reaches back to the middle of the 2nd abdominal segment; the joints are in the following proportions:

Joint	1	2	3	4	5	6	7	8-9-10	11	12-13	14	15	16	17
	31	73	35	31	34	34	34	57	31	31	34	42	42	50	50	50
	18	12	20	21	22	23	24-25							
	50	54	46	56	42	50	38	15 = 1000;						

the joints 8-9-10, 12-13 and 24-25 are fused; the joints 20 and 21 are fused on the right side; the 3rd joint has a very long distal seta. The 2nd antenna as in the female, and bears three prominences on the 2nd joint of the exopodite. The mandible has a robust 2nd basal joint; the exopodite about as long as the endopodite (13 : 15). The 1st maxilla has a large endopodite bearing 10 setae; the endopodite reduced, has 11 setae; the 1st inner lobe much reduced. The 2nd maxilla reduced; the first three lobes are furnished with only poor setae. The maxillipede as in the female.

The 1st to 4th swimming legs as those of the female. The 5th pair of legs slender, consist of 2-jointed basal joint and 3-jointed exopodite and 1-jointed endopodite; the right leg is longer than the left, the distal joint of the right leg is furnished with hairs as shown in the figure.

Remarks. The specimen differs from *D. frigidus* in the segmentation of the cephalothorax, and in the absence of the 5th leg in the female. But in other respects the specimen is so closely allied to the genus *Drepanopsis* that I dare regard the present specimen as congenerous with *Drepanopsis*. The structure of the male 5th legs also indicates a close affinity to *Drepanopsis*.

Occurrence. Three females and one male in the vertical hauls from 1000 m to the surface in Sagami Bay.

Genus *Tanyrhinus* FARRAN, 1936

FARRAN created a new genus *Tanyrhinus* to accomodate a small Calanoida closely resembling to *Mimocalanus* FARRAN. The generic characters are as follows: the head and the first thoracic segment are separate; the 4th and the 5th thoracic segments are separate; the abdomen 4-jointed; the 1st antenna 23-jointed, the joints 8-9 and 24-25 being fused; the 2nd antenna as in *Mimocalanus*, with two setae on the inner margin of the 2nd joint of the exopodite; the mandible with a large two-branched palp; the endopodite longer than the exopodite; the maxilla as in *Mimocalanus* and *Spinocalanus*; the 2nd maxilla as in *Paracalanus*, except that the 4th lobe is longer than the 1st; the maxillipede is of *Mimocalanus* type, with well developed setae; the 1st and 2nd joints of the exopodite of the 1st leg without inner marginal seta, and the terminal joint of the endopodite of the 2nd to 4th legs have four inner marginal setae; the 5th leg absent.

The genus comprises only one species, *Tanyrhinus naso* FARRAN. Up to the present time no example of the genus has not been met with in the Izu region.

Ryocalanus TANAKA, 1956

Cephalothorax elongate; the head is separate from the 1st thoracic segment, and so are the 4th from the 5th; rostrum stout, one-jointed; the abdomen 5-jointed in the male; 1st antenna 24-jointed, the joints 8 and 9 are fused; in the male right antenna is transformed into a grasping organ, the joints 23 and 24 are fused, the hinge exists between the joints 22 and 23. 2nd antenna as in *Drepanopsis*, with three setae on the inner margin of the 2nd joint of the exopodite, the 1st basal joint has a brush of hairs in posterior aspect. Mandible with a slender palp, the endopodite 2-jointed, shorter than the exopodite. 1st maxilla as in *Mimocalanus*, but in the exopodite, 2nd basal joint and lobes are slender. 2nd maxilla as in *Pseudocalanus*, the 5th lobe is the largest. Maxillipede as in *Drepanopsis*, except that the distal two joints are furnished with well developed setae on the outer margin. 1st to 5th swimming legs as in *Spinocalanus* and *Monacilla*, except that the distal joint of the exopodite of the 1st leg has a spine on the outer margin about the middle of the joint. The 5th legs of the male as in *Pseudocalanus*.

Ryocalanns infelix TANAKA

Ryocalanus infelix TANAKA, 1956, p. 3, figs. 1 and 2.

Male. Length, 2.18 mm; cephalothorax, 1.93 mm, abdomen, 0.25 mm; the head separates from the 1st thoracic segment; the last two thoracic segments are separate; the cephalothorax elongate ovate, the head contracts anteriorly; the last thoracic segment produced into an acute spine on each side, directing ventrally; the ventral

margin of the segment is furnished with fine spinules; the rostrum one-pointed, and acute, there is, in lateral view, a notch on the posterior surface near the distal end.

The abdomen 5-jointed, the segments and the furca in the proportional lengths 32 : 18 : 11 : 7 : 14 : 18=100; the 1st abdominal segment about half as long as wide, and is furnised with fine spinules on the distal corner of the right side, the 2nd to 4th segments are fringed with spinules on the distal margin; the furcal rami wider than long, carries five setae, of which the outermost is short and slender, the dorsal surface of the rami furnished with minute spinules, the appendicular seta short.

The left 1st antenna broken off in the distal part, the joints 8–9 are incompletely fused on the anterior margin, the joints 1 to 15 are in the proportions:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15
	20	14	5	5	5	5	4	7	5	6	6	6	6	6

The right antenna forming a grasping organ, extends to the distal margin of the 2nd thoracic segment; the joints 8–9 are entirely fused, the joints 18 to 22 are inflated; each joint with a distal seta and an aesthetask on the anterior margin; joint 20 has a seta on the posterior margin, the joint 21 has fine denticles and a seta on the posterior margin; the joint 22 is highly chitinised on the posterior margin and has a short distal seta, the joint 23 and 24 are incompletely separate, and forms a comb-like projection furnished with 19 denticles on the posterior margin; there is a minute seta at the junction with the 24th joint; the 24th joint has also a distal seta on the anterior and posterior margins; the joint 25 has five setae and an aesthetask; the joints 12 to 19 are furnished with hairs on the posterior margin.

The 2nd antenna has the exopodite about as long as the endopodite; the exopodite 7-jointed, the joint 2 has three marginal setae; the distal joint of the endopodite has 8+6 setae. The mandible has the exopodite slightly longer than the endopodite; the exopdite 5-jointed; the endopodite 2-jointed, and has ten setas on the 2nd joint; the 2nd basal joint carries three setae; the cutting edge has eighe teeth. The 1st maxilla well developed; the outer lobe has four long and two short setae; the exopodite has 7+4+4, the 2nd basal five; the 3rd inner lobe four; the 2nd inner lobe five; the 1st inner lobe fourteen spines. The 2nd maxilla is of normal type; the 1st lobe has four setae, the 2nd to 5th have each three setae; the 6th lobe has two setae; of which the distal one is short; the endopodite has six setae; the 1st basal has an outer marginal seta. The maxillipede slender; the outer marginal seta on the 4th and the 5th joint of the endopodite long; the 2nd joint of the endopodite is the largest.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the outer edge spine of the joints of the exopodite are long; the 3rd joint has four inner marginal setae, and two outer marginal spines; the distal half of the outer margin is hollowed; the endopodite has a process on the proximal outer margin; the 2nd basal joint has a row of spinules on the inner distal margin at the base of the endopodite; the exopodite of the right leg has an abnormal structure: the inner marginal setae on the

2nd and 3rd joint of the exopodite are converted into strong spines. The 2nd leg has 3-jointed exopodite and 2-jointed endopodite; the joints of the exopodite, especially the 2nd and the 3rd joints are densely covered with fine spinules on the posterior surface; the 3rd joint has five inner marginal setae; the posterior surface of the joints of endopodite are furnished with groups of spinules; the terminal spine of the exopodite has 23 teeth which are connected with a sort of thin lamella; the outer margin of the 2nd joint and the proximal section of the 3rd joint of the exopodite have, beside acicular spines, a row of slender and curved spines as shown in the figure; this arrangement of the spinules is observed also in the exopodite of the 3rd and 4th legs. The 3rd leg has 3-jointed exopodite and endopodite; the joints of the exopodite and endopodite are furnished with spinules as in the 2nd leg; the terminal spine of the exopodite has 25 teeth; the 3rd joint of the endopodite has six setae in all. The 4th leg has 3-jointed exopodite and endopodite; the structure as in the 3rd leg; the terminal spine of the exopodite is very finely serrated.

The 5th legs consist of five joints; the left leg much longer than the right; the terminal joint has two apical spines; the right leg has an outer edge spine on the 3rd joint; the terminal joint has two unequal apical spines.

Remarks: The specimen appears to be allied to *Autanepsis*, described by WOLFENDEN in the report of the "Süd-polar Expedition" in the structure of the swimming legs, but mouth parts are entirely different. The grasping antenna of the present specimen differs from those found in the tribe Heterarthrandria which has a movable articulation between the joints 18 and 19. The structure of the 1st to 4th legs resemble those of Pseudocalanidae, yet the peculiar structure in the grasping antenna has not, so far as I am aware, been reported, and I accommodate, at the present time, this curious specimen in the new genus under the name *Ryocalanus infelix* in memory of my only son who lost his life early in his boyhood. The description and figures of the species were published in "Breviora," Museum of Comparative Zoology of Harvard University, No. 64, October 11, 1956.

Occurrence. One adult male in the vertical haul from the depth 1410 m to the surface, in Suruga Bay, Nov., 1938.